United States General Accounting Office

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Report to the Chairman, Subcommittee on Research and Development, Committee on Armed Services, House of Representatives

September 1991

TACTICAL AIRCRAFT

Issues Concerning the Navy's Maritime Patrol Aircraft

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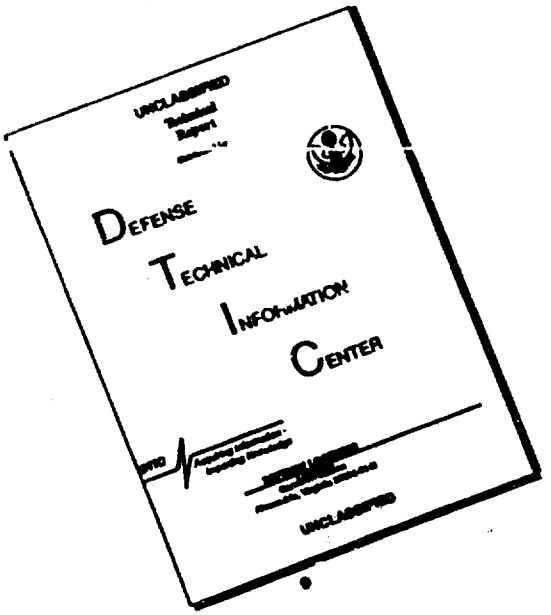

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United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-244844

September 4, 1991

The Honorable Ronald V. Dellums
Chairman, Subcommittee on Research
and Development
Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

In response to discussions with your office, we prepared this update of the Navy's maritime patrol aircraft program. These land-based aircraft are used primarily to search for submarines and surface combatants. In this report, we present a profile of the current maritime patrol fleet and its remaining service life and a chronology of Navy efforts to meet maritime patrol requirements. This report is intended to provide information to assist you and your staff in deliberations on subsequent Navy replacement proposals.

Results in Brief

Since the mid-1980s, the Navy has pursued several alternatives, including the canceled P-7A development program, to address expected patrol aircraft retirements starting in the late 1990s. Currently, the Navy has no proposal for replacing patrol aircraft, but is evaluating a program to procure an upgraded version of the P-3C. The Navy is reducing its maritime patrol force level and subsequently lowering its inventory requirements, but Navy projections indicate that in the late 1990s the patrol fleet will fall below inventory requirements. A possible service life extension for patrol aircraft could defer retirements 6 years and lessen the urgency for acquiring aircraft for a few years.

Background

Primary missions of the Navy's patrol aircraft include detection, location and, during wartime, destruction of enemy submarines and surface combatants. Lockheed-manufactured P-3B and P-3C aircraft perform these missions around the world, using antisubmarine and other electronic sensors to conduct ocean surveillance. At the beginning of fiscal year 1990, the Navy had about 400 aircraft to fulfill an inventory requirement of 443.

Force Level Reductions and Service Life Extension May Lessen Impact of Retirements

Over the next 15 years, the size of the maritime patrol fleet will decline dramatically if all the proposed force level changes, congressionally directed spending constraints, and projected retirements occur. Beginning in fiscal year 1990, the Navy began a series of maritime patrol aircraft force level reductions in response to declining defense budgets and the recognition of a changed threat environment. By fiscal year 1994, planned force level changes will reduce the inventory requirement to about 300 and the fleet from nearly 400 aircraft to about 300.

The 1991 National Defense Authorization Act prohibits the Navy from spending funds to operate or maintain P-3B model aircraft after fiscal year 1996. Removing these aircraft would reduce the fleet to under 250 aircraft or about 50 below the Navy's inventory requirement. By fiscal year 2000, retirements are projected to reduce the fleet by an additional 15 aircraft. Over a 5-year period, beginning in fiscal year 2000, about another 80 aircraft are expected to be retired, bringing the patrol fleet to about 150 aircraft in fiscal year 2005.

Results of the Navy's current P-3 service life assessment may postpone the retirements expected in the late 1990s and early into the next decade. Periodically, the Navy reevaluates its aircraft service life limits. Preliminary analysis of fatigue life, flying hour limits, and aircraft reliability suggests that patrol aircraft may safely fly 6 years longer than previously anticipated (at current usage rates).[1] However, the corrosive environment these aircraft fly in may mitigate some of the service life increase. The Navy attempts to minimize the corrosion, but predicting its effect on aircraft service life is difficult. Nonetheless, the Navy could have almost 90 additional aircraft flying in the year 2005, or a patrol force of about 240 instead of 150 if an extension of the service life were approved. Assuming that the fiscal year 1994 force level does not change, potential fleet stability beyond the year 2000 could lessen the urgency to acquire aircraft for a few years.

Navy's Replacement Plans Suspended

At present, the Navy has no proposal for replacing patrol aircraft. Fiscal year 1991 Defense Appropriations Conference Committee language instructs the Navy to obtain prior congressional approval before embarking on a new program. In July 1990, the Navy terminated for default its P-7A development contract for a new plane. Last fall, the Navy evaluated options for a new program, and its leading alternative

[1]Fatigue life measures how long an aircraft will last under repeated cyclic stresses, such as takeoffs and landings.

then was a remanufacture (known as the P-3H) of existing aircraft. Navy officials estimated remanufacture would cost between $35 million and $40 million per plane, plus nearly $1 billion in development costs. In December 1990, the Secretary of the Navy withdrew this proposal from the Navy's fiscal year 1992 budget plans as part of a decision to meet the deficit reduction plan's fiscal year 1992 budget target.

The Navy is reevaluating an option to buy new P-3C patrol aircraft (the Navy's latest version patrol aircraft), following the Republic of Korea's December 1990 decision to buy eight of the Lockheed planes. Prior to Korea's commitment, Lockheed was in the process of closing its P-3 production line.

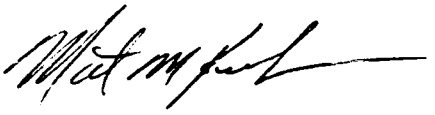
Agency Comments

In commenting on a draft of our report, the Department of Defense agreed with our discussion of the current maritime patrol fleet profile and anticipated changes to requirements and inventory over the next several years. The Department also agreed with our chronology of Navy efforts to acquire a new patrol aircraft. The Department added that although no budget proposal for new aircraft is before the Congress, the Navy is evaluating a number of options to meet the maritime patrol requirement, including procuring a new minimally modified P-3 in conjunction with the Korean purchase. While acknowledging the possibility of a service life extension for patrol aircraft, the Department does not agree that a service life extension of 6 years is likely or practical for patrol aircraft inventory. The Department felt that it is very possible that corrosion will be more of a determining factor of service life than will fatigue life. Also, they stated that operating old aircraft could lead to high operating costs. We recognize and state in our report that a service life extension involves more than an assessment of fatigue life. However, throughout our assessment of the remaining service life of patrol aircraft, Navy program officials provided no analysis on corrosion effects fleet-wide, associated costs for repair, or how much higher operating costs may be. Until the Navy develops an estimate of corrosion and its cost, it will not be in a position to know when it is appropriate to buy new aircraft.

We will provide copies of this report to the Chairmen, Senate Committee on Governmental Affairs, House Committee on Government Operations, Senate Committee on Armed Services, and Senate and House Committees on Appropriations; Director, Office of Management and Budget; and the Secretaries of Defense and the Navy. Appendixes I and II provide

further details on the results of our work, appendix III explains our methodology, and appendix IV contains the Department of Defense's comments. Major contributors to this report are listed in appendix V. If you have questions or need additional information please contact me on (202) 275-6504.

Sincerely yours,



Martin M Ferber
Director, Navy Issues

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Abbreviations

DAB	Defense Acquisition Board
OSD	Office of the Secretary of Defense
RFP	Request for Proposal

P-3 Requirements and Fleet Profile

Primary missions of the Navy's maritime patrol aircraft include the detection, location and, during wartime, destruction of enemy submarines and surface combatants. These turboprop, land-based P-3 aircraft[1] are required to operate over a 1,600-nautical mile range; remain on station for 4 hours; and carry a mission payload consisting of a full crew, armament, and antisubmarine and other electronic search sensors. P-3 aircraft perform these missions around the world using antisubmarine and other electronic sensors to conduct ocean surveillance.

At the beginning of fiscal year 1990, the Navy's maritime patrol fleet numbered 395 aircraft and consisted of three models designated A, B, and C. Nearly two-thirds, or 249, of the planes were the most recent version—the P-3C. Less than 10 percent, or 38, were the original model, the P-3A and about 25 percent, or 108, were P-3Bs. The B model has two versions, a lightweight and a heavyweight. The lightweight model is structurally similar to the P-3A, but has a more powerful engine. The heavyweight model P-3B has the more powerful engine and a stronger airframe, which allows the plane to carry larger payloads and more fuel. The P-3C airframe is similar to the heavyweight P-3B, but the P-3C itself carries a different mission avionics package. Active squadrons primarily flew P-3Cs, while most reserve squadrons had P-3As and P-3Bs.

Maritime Patrol Fleet Composition and Size Will Change Dramatically During the 1990s

Over the next 10 years, the size of the maritime patrol fleet will decline dramatically. If all the proposed force level changes, congressionally directed spending constraints, and projected retirements occur, the fleet will decrease from the fiscal year 1990 level of 395 aircraft to 246[2] by the end of fiscal year 1996. By fiscal year 2000, the fleet would number 232 aircraft and after 1996, would consist of only P-3Cs.

Most of the change will be brought about by force level changes that will reduce the fleet from 37 squadrons to 27 squadrons and, as a result, lower the inventory requirements. For many years the Navy had a patrol force of 37 squadrons (24 active and 13 reserve) of 9 aircraft each, or 333 planes. To ensure sufficient aircraft and trained crews to operate the 37 squadrons, the Navy needed additional aircraft for activities such as training, research and development, and repair pipeline,[3]

[1]The P-3 is a military derivative of a Lockheed commercial aircraft—the Electra.

[2]This and subsequent inventory figures in this report recognize the loss of two P-3Cs due to a March 1991 mid-air collision, as noted in DOD's comments.

[3]Repair pipeline aircraft are those needed to preserve squadron size while aircraft undergo maintenance.

for a total inventory requirement of 443 planes. In fiscal year 1990, the Navy had about 50 fewer aircraft than its inventory requirement.

By fiscal year 1994, recent DOD program budget decisions will reduce the Navy's P-3 inventory requirement by approximately 145 aircraft (see table I.1). According to the Chief of Naval Operations, the less immediate Soviet submarine threat has enabled the size of the maritime patrol aircraft fleet to be reduced. Other Navy officials have stated that these decisions are budget driven. An April 1989 Secretary of Defense decision required the Navy to reduce active squadrons to eight planes each and reserve squadrons to six each, effective fiscal year 1991. Also, a November 1990 program budget decision requires the Navy to eliminate four active squadrons during fiscal year 1991. Finally, a December 1990 program budget decision requires the Navy to reduce the number of active squadrons to 18 and reserve squadrons to 9 by fiscal year 1994. However, in fiscal year 1994, squadron size for the reserves will increase to 8 planes or the same as active squadrons.

Table I.1: Declining P-3 Force Level and Inventory Requirements

Fiscal year beginning	Force level (squadrons)	Inventory requirement (aircraft)
1990	37	443
1991	37	367
1992	33	328
1993	33	328
1994	27	298

By the end of fiscal year 1996, or 3 years later, the Navy must remove any remaining model P-3B aircraft from the fleet. The National Defense Authorization Act for Fiscal Year 1991 prohibits the Navy, after September 1996, from using funds to maintain or operate P-3B aircraft. With the removal of the B model, the fleet will comprise of only P-3Cs. (By February 1991, the Navy had removed all P-3A aircraft from the fleet to meet the April 1989 Secretary of Defense decision.)

If the 27-squadron force level planned for fiscal year 1994 remains the same in subsequent years, the prohibition on funding for P-3Bs will lower the fleet size below the inventory requirement of 298. The fleet size will be 246, or 83 percent of the inventory requirement, as opposed to the 89 percent held in fiscal year 1990 (see table I.2).

Table I.2: Comparison of Inventory Requirements and Fleet Size Fiscal Years 1990 and 1997

Fiscal year	Inventory requirement	Fleet size	Percent of requirement
1990	443	395	89
1997	298	246	83

Fleet Changes After 1996 Dominated by Retirements

After these changes, projected retirements will dominate reductions in the fleet. During fiscal years 1997-1999, the Navy projects that 15 aircraft will reach the end of their service lives. Then, from fiscal year 2000 to fiscal year 2005 about 16 aircraft a year will retire, reducing the fleet to 152 aircraft, nearly one-half the inventory requirement (see table I.3).

Table I.3: P-3 Fleet Changes, Fiscal Years 1990 to 2005

Beginning fiscal year	Projected retirements	Force level reductions	Inventory
1990	•	•	395 (actual)
1992	0	67	328
1994	0	30	298
1997	1	49	246
2000	14	0	232
2005	80	0	152

Current Fleet Profile

To comply with the April 1989 DOD decision, the Navy reduced its patrol aircraft fleet from 395 planes, at the beginning of fiscal year 1990, to 344 planes, as of February 1991. This reduction of 51 aircraft consisted of 38 P-3As and 13 P-3Bs. Thirty aircraft were transferred to foreign military sales, 13 to other Navy activities (e.g., reconnaissance), 6 to other U.S. government agencies (e.g., the U.S. Customs Service), and 2 to war reserve storage and spare parts usage.

In February 1991, over 70 percent of the maritime patrol aircraft fleet was comprised of the most recent P-3 version—the P-3C (see table I.4).[1] P-3Bs made up the balance of the fleet.

[1]Inventory numbers are based on a September 1990 Aircraft Inventory Reporting System report, updated by Navy officials to reflect subsequent aircraft deletions and transfers. Tables I.4, I.5, and I.6 are based on this report.

Table I.4: Patrol Aircraft by Model, February 1991

Model	Number of planes	Percent
Lightweight P-3B	59	17.1
Heavyweight P-3B	36	10.5
P-3C	249	72.4
Total	**344**	**100.0**

Although assessing the condition of a particular patrol aircraft requires detailed analysis, the Navy uses several service life measures to monitor the overall status of its fleet. One such measure limits P-3 service life to approximately 30 years. Another P-3 service life estimate is 20,000 flight hours. The Navy also considers structural fatigue, material condition, and the cost of operation and maintenance when determining individual aircraft retirement dates.

For replacement planning purposes, Navy officials project when each aircraft will retire, based on the 20,000 flight hour P-3 service life limit. Using its methodology, the Navy determines each aircraft's remaining service life based upon each model's average flight hour utilization rate. The result is then adjusted for non-operating time to estimate years to retirement. Navy officials also adjust the results to reflect the P-3 attrition rate experienced over the past 5 years—about one crash every 4 years.

As of September 1990, over 35 percent of the Navy's patrol aircraft fleet was more than 20 years old (see table I.5). Over 40 percent was between 10 and 20 years old. Only 22 percent were in service less than 10 years.

Table I.5: Number of Planes by Years in Service, September 1990

Years in service	Number of planes	Percent of current inventory
Less than 10	76	22.1
10 to 20	144	41.9
More than 20	124	36.0
Total	**344**	**100.0**

While the average P-3 has logged 10,455 flight hours, a wide variation exists between the C and B models (see table I.6). The P-3Cs only average 8,619 flight hours per plane, while the B versions have used well over 70 percent of their flight hours. The heavyweight P-3Bs, with an average of 16,057 hours, or 80 percent of the maximum, are the nearest to retirement.

Table I.6: Average Flight Hours by Model, September 1990

Model	Average flight hours	Percent of 20,000 hour maximum
Lightweight P-3B	14,788	73 9
Heavyweight P-3B	16,057	80 3
P-3C	8,619	43 1
Fleet Average	**10,455**	**52.3**

Preliminary Analysis Suggests Longer P-3 Service Life

Assessment of the P-3 service life, currently underway, may significantly impact the maritime patrol fleet. The Navy periodically reevaluates flight hour limits, or, more accurately, the fatigue damage accrual rate from which it derives flight hour limits. Preliminary analysis indicates that the 20,000 hour limit for the P-3 could be extended to 24,000 hours or more, which represents an additional 6 years of service life at current usage rates. However, further work must be done before the Navy endorses any increase. Also, the extension may be lessened if other factors such as corrosion or cost of operation and maintenance become unmanageable. However, should the Navy approve it, the large number of retirements anticipated in the early years of the next decade would not occur until the end of the decade. Using the Navy's retirement projection methodology and assuming a 24,000 flight hour limit, the fleet size would remain at 249 aircraft through the decade and drop to 239 by fiscal year 2005 (see table I.7). This stability in the fleet size beyond 1997 could lessen the urgency to acquire additional aircraft for a few years.

With the higher flight hour limit, a P-3C that would have retired in 1996 would now retire in the year 2002.

Table I.7: Projected Fleet Size With Different Life Limits

Beginning fiscal year	20,000 flight hour limit	24,000 flight hour limit	Difference
1997	246	247	1
2000	232	248	16
2005	152	239	87

Aircraft service life limits are derived from structural fatigue test demonstrations. Fatigue failure is the cracking of metal under repeated stressing. For example, bending a paperclip until it breaks is a fatigue failure. Similarly, aircraft structures are exposed to cyclic stresses in flight, such as fuselage pressurization and depressurization. To ensure

safety, the Navy retires an aircraft before it reaches its estimated fatigue limit.

Aircraft designers estimate structural fatigue life—the number of cycles and stress levels the structure can withstand prior to failure—through analysis and testing. The Navy then translates fatigue life into flight hour limits, based on assumptions about the rate at which fatigue damage will occur. This rate will vary depending on several factors, including the rate at which the plane accrues flight hours, the severity of maneuvers, and the weight of the payload.

While the aircraft model is in service, the Navy periodically conducts service life assessment programs to reevaluate its fatigue damage accrual estimate, flight hour limits, and operational availability and reliability. Based on these assessments, the P-3's service life limit has increased from 7,500 flight hours to 20,000. Over the years, the Navy found that P-3 flying patterns were not as severe as had been assumed. The original limit was based on conservative assumptions about in-flight stresses (e.g. maneuvers and payload), while the higher limit reflected actual operating experience and more modern analysis of the original fatigue test data.

In January 1991, the Navy initiated a $5-million P-3 service life assessment, expected to be completed by August 1992. Navy officials said the assessment includes the following segments:

- instrumented flight survey, in which extensive monitoring equipment is attached to six sample planes;
- a wing tear down, where an older wing will be disassembled and microscopically analyzed; and
- development of a computer model that will identify how stress is distributed through the aircraft's structure.

Also, Navy officials stated that they plan to analyze maintenance and logistics data to identify ways to reduce escalating maintenance costs and flight risks on aging P-3s.

Preliminary analysis of the completed assessment segments indicates that P-3s may safely fly more than 20,000 hours, according to Navy officials. These officials suggest that the P-3's service life might be extended at least 4,000 flight hours, yielding an additional 6 years of service (at current usage rates). In the past, because of the limited ability to model precisely how aircraft structures respond to stress, designers had to

assume the most extreme scenarios. The current assessment program is designed to provide analysts more detailed, accurate data for more comprehensive modeling. The more accurate measurements indicate that, even though in recent years P-3s are flying more aggressively, fatigue damage is accruing at a slower rate than previously thought. However, before the Navy endorses a longer service life it wants to do additional analysis such as the wing teardown to provide physical confirmation of the model analysis.

Fatigue Life Limits Do Not Account for Corrosion

In addition to fatigue, Navy officials said that analysts need to consider the aircraft's material condition, particularly the level of corrosion, prior to extending service life. However, because so many and such varied factors affect corrosion, scientists have difficulty making quantitative predictions about its effects. Nonetheless, some experts believe that corrosion may mitigate the benefits of a fatigue life extension.

Corrosion, an electrochemical deterioration caused by reaction with the environment, weakens metal and makes it more vulnerable to fatigue. It occurs when a corrosive fluid, such as salt water, comes in contact with metal. While corrosive attack begins on the surface, it can penetrate into the metal if allowed to progress. Several factors influence the rate of corrosion, including the type of metal, the amount of mechanical stress on the material, temperature, and the length of exposure to the corrosive fluid. Dirt, salt, and engine exhaust can dissolve on wet surfaces, increasing the corrosion rate. Also, according to Navy officials, the high-strength aluminum used on virtually all aircraft designed between the mid-1950s and mid-1970s (including the P-3) is prone to corrosion.

To minimize the effects of corrosion, the Navy performs routine rinsing and frequent washing of its aircraft. Also, chemical surface treatments and paint finishes are routinely inspected and repaired. The severity of the environment determines the frequency of inspections. Early detection, identification, and treatment of potential corrosion minimizes its effects.

To define service life limits, fatigue estimates are reduced by two-thirds to account for material variability and crack initiation (rather than failure). The 20,000 flight hour, P-3 service life limit reflects this reduction to ensure that 99 percent of the planes will remain free of fatigue crack initiation. However, this analysis assumes that all routine maintenance, inspections, and corrosion control techniques are performed

properly. Also, fatigue testing is performed without attempts to simulate corrosive operating environments.

Corrosion can be quite detrimental to fatigue life. A study by the North Atlantic Treaty Organization's (NATO) Advisory Group for Aerospace Research and Development found that corrosion alone may reduce fatigue life by one-half to two-thirds even when the material is treated with corrosion inhibiting compounds. Also, the Navy's corrosion control manual states that untreated 7075-T6 aluminum (the material used on P-3s) can fail by stress corrosion cracking in the presence of a stress equal to only 10 percent of its strength. In addition, fatigue corrosion occurs at a stress far below the fatigue limit even though the amount of corrosion is small.

Because of the potential severity of corrosion effects, some Navy corrosion experts expressed serious concern about model-wide service life extensions. First, control techniques minimize corrosion, but do not eliminate it altogether. Some aircraft sections are simply not accessible for inspection and corrosion prevention and treatment. Also, as planes age corrosion control becomes more difficult. Paint fails and metal is exposed. Joints are loosened with repeated servicing, allowing moisture infiltration and rubbing. Furthermore, corrosion effects are cumulative. For the above reasons, these officials believe that the Navy should allow service life extensions only on an aircraft by aircraft basis after rigorous inspections. However, in practice the Navy uses the flight hour limit for planning purposes and inspects each aircraft at regular intervals to assure airworthiness. Also, the P-3 incorporates design features that enable the plane to still land safely if a critical member fails. For example, P-3 wings consist of a series of separate panels mounted together by rivets. Thus, if a crack develops in the wing, it is limited to a single panel.

Navy Efforts to Acquire New Aircraft

In the mid-1980s, the Navy initiated efforts to replace the large number of P-3 aircraft estimated to reach the end of their useful service lives during the 1990s. Over the years, the P-3C, the Navy's latest model P-3 aircraft, has lost some of its range and time on station capabilities because of heavier required payloads. The Navy sought a replacement plane with increased payload and at least the original P-3C range. The Navy also sought an aircraft with newer technology that could reduce support costs and provide enhanced antisubmarine warfare capabilities.

The envisioned aircraft was a derivative of the P-3C and became known as the P-3G. It was to include improved engines, reliability, maintainability, and survivability enhancements, vulnerability reductions, and advanced mission avionics. The Navy planned to acquire 125 P-3G aircraft over a 5-year period. The Navy had been buying various versions of the P-3 from Lockheed without competition for many years, and it believed that introducing competition into further procurement would result in cost savings. The Navy sent a request for information to industry in May 1986. Using information obtained from the respondents, the Navy developed a P-3G specification that met its operational requirements. In August 1936, Office of the Secretary of Defense (OSD) officials approved the P-3G program.

Navy Expanded Competition

In January 1987, the Navy released a draft request for proposal (RFP) for the P-3G. Following release of the draft RFP, no company other than Lockheed indicated an interest in building a P-3C derivative. Unwilling to award a contract to Lockheed without competition, the Navy expanded the scope of competition in March 1987 to include modified commercial aircraft as well as aircraft based on the P-3C design.

In May 1987, OSD directed the Navy to conduct a patrol aircraft mission requirements determination study (payload, range, speed, survivability, etc.). To complement this study and enhance the RFP, the Navy released a draft RFP to industry soliciting comments on the operational potential of commercial derivative aircraft to perform the patrol aircraft mission. In September 1987, the Navy released a final RFP, incorporating the findings of the OSD- directed study and the responses from industry. Three proposals were received and evaluation began in February 1988. In October 1988, the Navy selected Lockheed as the winner of the competition. Lockheed's proposal was significantly lower in cost than proposals submitted by Boeing and McDonnell Douglas. It was also judged to be technically superior, with a less risky technical approach.

On January 4, 1989, the Defense Acquisition Board (DAB) recommended full-scale development of the program. The next day, the Navy awarded a fixed-price incentive contract to Lockheed to design, develop, fabricate, assemble, and test two prototype aircraft, designated the P-7A. The contract had a target cost of $600 million and a ceiling price of about $750 million. In March 1989, the Navy estimated acquisition of 125 P-7A aircraft at about $7.9 billion (escalated dollars). Of this total, development cost was estimated at $915 million (escalated dollars). Procurement of each production version aircraft was estimated at about $56.7 million.

Development Contract Terminated for Default

In November 1989, Lockheed announced a $300-million cost overrun in its development contract due primarily to schedule and design problems. In the following months, Navy and Lockheed officials held extensive but unsuccessful discussions in an attempt to address the contract issues. By letter dated July 20, 1990, the Navy terminated the P-7A development contract for default, citing Lockheed's inability to make adequate progress toward completion of all contract phases. This decision left the Navy without a program to replace its aging P-3 aircraft.

P-3H Remanufacture Became Leading Alternative

As of late 1990, the Navy program office's leading candidate to replace the canceled P-7A program was the P-3H remanufacture of existing P-3 aircraft. The P-3H proposal, which OSD had not yet approved, had three primary goals. First, the Navy wanted to extend the service life of existing P-3 aircraft primarily by replacing the wings and landing gear and treating fuselage corrosion. The second goal was to improve the fleet's range and endurance by replacing each aircraft's engine with a new, more powerful one. Finally, the program office believed a remanufacture would allow the P-3s to meet their operational requirements, by adding an advance avionics suite (called Update IV), survivability enhancements, extended range Harpoon missiles, and more sonobuoys (acoustic sensors that are dropped into the ocean). Navy officials estimated remanufacture of P-3s would cost between $35 million and $40 million per plane, plus nearly $1 billion in research and development costs.

While the P-3H was the leading P-7A replacement candidate, other options were also under consideration. These included

- reopening Lockheed's P-3C production line either with or without modifications such as a new engine and/or inflight refueling capability;

- adapting the Air Force's C-130 for antisubmarine warfare missions;
- modifying a commercial jet (rather than turboprop) airframe to meet antisubmarine warfare requirements; and
- developing a turboprop airplane with extended range, increased payload capacity, and improved fuel efficiency (P-7A concept).

As part of the P-3H proposal, Navy program office officials formulated an 8-year development program, beginning with $89 million for various early development activities in fiscal year 1991, and $438 million during fiscal years 1992 and 1993. At a tentatively scheduled December 1990 DAB review, Navy officials hoped that they would receive approval to focus development efforts on the P-3H alternative. Following a successful P-3H engineering/risk reduction effort Department of Defense approval to proceed into full-scale development (Milestone II) was tentatively scheduled for late 1991 or early 1992.

Because the President's fiscal year 1991 budget request contained funding for the terminated P-7A program, the Navy Comptroller submitted an appeal to the House Appropriations Committee in an attempt to obtain a portion of these funds for the P-3H proposal. Citing House Appropriations Committee language specifying the need for prior Congressional approval to initiate a P-3H or other new program to replace the P-7 effort, the Conference Committee denied fiscal year 1991 funding.

P-3H Remanufacture Option Canceled

In early December 1990, the Secretary of the Navy, in meeting the fiscal year 1992 budget target set in the deficit reduction plan approved in October, removed the P-3H proposal from the Navy's fiscal year 1992 and 1993 funding plans due to affordability and program maturity concerns. As a result, the planned December DAB review was not held.

As a result of these events there are no research and development or procurement funds in either the fiscal year 1991 budget or the Navy's fiscal year 1992 budget request for a P-3 replacement program.

Reopening of P-3C Assembly Line Has Navy Considering Acquiring New P-3Cs

On December 10, 1990, Lockheed announced that the Republic of Korea's Navy selected the P-3C to conduct its future maritime patrol missions. The company expects to build eight aircraft for delivery to Korea in 1995. Prior to Korea's commitment, Lockheed was in the process of closing its P-3C production line.

With the reopening of the assembly line, the Navy is now reevaluating procurement of new P-3Cs with many of the same improvements planned for the P-3H remanufacture program. The Navy evaluation also includes discussions with Great Britain and Germany, who were previously interested in the P-7A. The Department of Defense comments to a draft of this report indicate that, in conjunction with the Korean purchase, the Navy could have the modified P-3 aircraft added to the fleet as early as fiscal year 1996.

Scope and Methodology

To develop the profile of the current maritime fleet and its remaining service life, we analyzed the current status of the P-3 fleet. To determine the February 1991 inventory, we adjusted the Navy's Aircraft Inventory Reporting System September 30, 1990, report based on information provided by the Navy's P-3 aircraft coordinator. We also examined the effect of fatigue and corrosion on aircraft service life. Specifically, we reviewed relevant studies and interviewed officials from Naval Air Systems Command in Arlington, VA; Naval Air Development Center (NADC) in Warminster, PA; the Naval Aviation Depot in Alameda, CA; and Naval Air Station, Willow Grove, PA. In addition, we studied the Navy's methodology for projecting aircraft retirements. To project P-3 retirements assuming a 24,000 flight hour service life, we used the Navy methodology adjusting those factors effected by a longer service life such as flight hours and operating service life. While we did not assess the system in detail, we were able to corroborate the Navy's results using NADC's Structural Appraisal of Fatigue Effects data base. We also reviewed Navy regulations and procedures governing aircraft inventory, fatigue life tracking, and corrosion.

To develop the chronology, we obtained information through discussions with cognizant Department of Defense and Navy officials and the review of key documents. We interviewed officials and reviewed records from the Department of Defense, Department of the Navy, Naval Air Systems Command, and Naval Air Development Center.

Our review was performed from July 1990 to March 1991 in accordance with generally accepted government auditing standards.

Comments From the Department of Defense

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
  Affairs Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "TACTICAL AIRCRAFT: Issues Concerning the Navy's Maritime Patrol Aircraft," dated June 18, 1991 (GAO Code 394378), OSD Case 8737. The DoD partially concurs with the report.

The DoD recognizes the maritime patrol aircraft inventory will be below required levels in the future and is reviewing various options to correct the problem. Those options include (1) a service life extension of the aircraft currently in operation and (2) the procurement of new aircraft.

A service life extension could possibly add up to six years of operational capability to existing aircraft, but long term exposure to the corrosive maritime environment could severely limit the percentage of aircraft that would benefit from this option. Therefore, the Navy is investigating alternatives for cost-effective procurement of new maritime patrol aircraft.

The detailed DoD comments on each report finding are provided in the enclosure.

Sincerely,

Charles E. Adolph
By Direction of the Secretary of Defense

Enclosure

GAO DRAFT REPORT - DATED JUNE 18, 1991
(GAO CODE 394378) OSD CASE 8737

"TACTICAL AIRCRAFT: ISSUES CONCERNING THE NAVY'S MARITIME PATROL AIRCRAFT"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

FINDING A: P-3 Requirements and Fleet Profile. The GAO reported that, over the next 15 years, the size of the maritime patrol fleet will decline dramatically if (1) all proposed force level changes are realized, (2) congressional direction is followed, and (3) projected retirements occur. The GAO observed that, in FY 1990, the Navy began a series of maritime patrol aircraft force level reductions in response to declining defense budgets and the recognition of a changed threat environment. The GAO reported that the fleet will decrease from the FY 1990 level of 395 to 248 aircraft by the end of FY 1996. The GAO noted that, by FY 2000, the fleet would number 233 aircraft--and after FY 1996, the fleet would consist of only P-3C aircraft.

The GAO reported that, according to the Chief of Naval Operations, the less immediate Soviet submarine threat has enabled the size of the maritime patrol aircraft fleet to be reduced. The GAO further reported, however, that according to other Navy officials, the reduction decisions are actually budget driven--rather than related to the reduced threat.

The GAO reported that the National Defense Authorization Act for FY 1991 prohibits the Navy from using funds to maintain or operate P-3B aircraft after September 1996. The GAO further reported that, assuming the 27 squadron force level planned for FY 1994 remains the same in subsequent years, the prohibition on funding for P-3s will lower the fleet size below the inventory requirement of 298 aircraft. The GAO noted that, in FY 1997, the fleet size will be 248, 50 aircraft below the inventory requirement. The GAO reported that, after FY 1996, fleet changes will be dominated by retirements, further reducing the fleet to 152 aircraft by 2005--nearly one half the inventory requirement.

The GAO observed that, for replacement planning purposes, Navy officials project when each aircraft will retire based on a 20,000 flight hour P-3 service life limit. The GAO reported that, as of September 1990, over 35 percent of the

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Navy patrol aircraft fleet were more than 20 years old and only 22 percent were in service less than ten years. The GAO noted that, while the average P-3 aircraft has logged 10,455 flight hours, the heavyweight P-3Bs have flown an average of 16,057 hours or 80 percent of their 20,000 flight hour service lift limit. (pp. 8-16/GAO Draft Report)

DOD RESPONSE: Concur. The information was factually accurate at the time the GAO audit was conducted. Due to a recent mid-air collision which resulted in the loss of 2 P-3Cs, the FY 1996 projection for the P-3C inventory is now 246, not 248. The GAO discussion of requirements is also correct, assuming a force level of 18 active and 9 reserve squadrons comes to fruition.

FINDING B: Preliminary Analysis Suggests Longer P-3 Service Life. The GAO reported that, while an aircraft model is in service, the Navy periodically conducts service life assessment programs to reevaluate fatigue damage accrual estimates, flight hour limits, operational availability and reliability. The GAO found that, based on these assessments, the service life of the P-3 has increased from 7,500 flight hours to 20,000 hours because (1) the actual P-3 flying patterns were not as severe as has been originally assumed, (2) the original limit was based on conservative assumptions, and (3) more modern analysis of the original fatigue test data pointed to a higher limit.

The GAO reported that the Navy, in January 1991, initiated a $5 million P-3 service life assessment expected to be completed by August 1992. The GAO noted that the results of the P-3 service life assessment may impact significantly the maritime patrol fleet by postponing the retirements expected in the late 1990s and early into the next decade. The GAO explained that preliminary analysis suggests that the 20,000 hour limit for the P-3 could be safely extended to 24,000 hours or more, adding six more years of service life at current usage rate and lessening the urgency of acquiring aircraft for a few years. The GAO noted that, if the service life extension is approved, the Navy could have almost 90 additional aircraft flying in the year 2005 -- or a patrol force of about 240 instead of 150. The GAO found, however, that the Navy plans to perform additional analysis before it endorses a longer service life.

The GAO also pointed out that some experts believe that the corrosive environment in which the patrol aircraft fly may mitigate somewhat the potential service life increase. The GAO noted that fatigue testing is performed without attempts to simulate corrosive operating environments. The GAO also noted that the service life assessment assumes that all routine maintenance, inspections, and corrosion control techniques are performed properly. The GAO reported that

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some Navy corrosion experts expressed serious concern about model-wide service life extensions because of the potential severity of corrosion effects. (The GAO explained that corrosion has a cumulative effect and is more difficult to control as planes age.) The GAO further reported that, according to the Navy corrosive experts, service life extensions should only be permitted on an aircraft by aircraft basis after rigorous inspections. (pp. 16-23/GAO Draft Report)

DOD RESPONSE: Partially Concur. While most of the information in the report is accurate, the DOD does not agree that the possibility of a service life extension is as likely or practical, as indicated by the report. The P-3 aircraft have been flown in highly corrosive environments for many years, and it is very possible that corrosion will be more of a determining factor than fatigue life in the service life of those aircraft. The Navy currently has an extensive corrosion prevention program for all maritime aircraft, but the effects of that harsh environment can still be devastating. In fact, the GAO found that corrosion alone may reduce fatigue life by 50 to 66 percent, even when material is treated by corrosion inhibiting compounds. Two P-3Bs have been retired in the past year alone due to massive corrosion problems, and neither was near the twenty thousand hour service life (sixteen thousand flight hours for one and seventeen thousand flight hours for the other). Even if a fatigue life extension is approved, which is not guaranteed, it is highly likely that only a portion of the aircraft inventory would be in good enough condition to be granted a life extension of six years. Following historical trends, if an extension were granted, the maintenance man-hour per flight hour costs could rise as much as fifteen percent per year.

FINDING C: Navy Efforts to Acquire New Aircraft. The GAO observed that, since the mid-1980s, the Navy has pursued several alternatives to address expected patrol aircraft retirements starting in the late 1990s. The GAO reported that, on January 5, 1989, the Navy awarded a fixed-price incentive contract to Lockheed to design, develop, fabricate, assemble, and test two prototype aircraft -- designated the P-7A. The GAO further reported, however, that on July 20, 1990, the Navy terminated the P-7A development contract for default, because Lockheed was unable to make adequate progress toward completion of all contract phases. The GAO concluded that the termination decision left the Navy with no proposal for replacing its patrol aircraft.

The GAO reported that, as of late 1990, the leading Navy candidate to replace the canceled P-7A program was the P-3H remanufacture of existing P-3 aircraft. The GAO noted

that the estimated remanufacture of the P-3s would cost between $35 million and $40 million per plane, plus nearly $1 billion in research and development costs. The GAO noted that other possible replacement options included (1) reopening the Lockheed P-3C production line, (2) adapting the Air Force C-130 for antisubmarine warfare missions, (3) modifying a commercial jet airframe to meet antisubmarine warfare requirements, or (4) developing a turboprop airplane with extended range, increased payload capacity and improved fuel efficiency.

The GAO noted that, in December 1990, the Secretary of the Navy withdrew a proposal to remanufacture existing aircraft as part of a decision to meet the deficit reduction plan FY 1992 budget target. The GAO observed that, as a result, there are no research and development or procurement funds in either the FY 1991 budget or the Navy FY 1992 budget request for a P-3 replacement program. The GAO reported that the Navy currently is reevaluating an option to buy new P-3C patrol aircraft with many of the same improvements planned for the P-3H remanufacture program, following the Republic of Korea December 1990 decision to buy eight of the Lockheed planes, which will keep the line open. The GAO noted that the Navy evaluation also includes discussions with Great Britain and Germany, who previously were interested in the P-7A. (pp. 24-30/GAO Draft Report)

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DOD RESPONSE: Partially concur. It is true that the Navy does not currently have a new aircraft in the budget proposal before the Congress, but there is an ongoing evaluation of a number of options to meet the inventory requirements of the Maritime Patrol Aircraft community. Those options include procuring new, minimally modified, P-3 aircraft in conjunction with the Korean purchase. That could allow the Navy to provide new aircraft to the fleet as early as FY 1996.

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RECOMMENDATIONS

None.

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